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ABSTRACT

Research indicates that aging processes include changes in health, social, and financial resources. A study was conducted to determine if three quantitative approaches to the measurement of longitudinal change would yield similar results when the relationship between subjective well-being and measures of health, social, and financial resources were analyzed. Three measures of longitudinal change were used, including difference scores, residual change scores, and percentage gain scores. Data were taken from the Retirement History Study by the Social Security Administration and the sample included 8922 respondents measured in 1969, 1971, and 1973. The dependent variable measured happiness. Health resources were measured by the General Disability and Overall Disability Indexes with a high score representing a high degree of disability. Social resources were measured by the Scope of Immediate Family and Size of Immediate Family Indexes, with high scores indicating that the respondent had a spouse, parent, child, and sibling. Respondents reported more disability and fewer social resources as they aged. When the approach to the measurement of change was varied, different results were obtained in terms of the amount of variance explained and in terms of the relative importance of the resource area for predicting happiness and change in happiness outcome. The use of difference scores and residual change scores together is needed in measurement of change in aging studies. (ABL)

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The measurement of change in well-being

M. Beaudet, B. Stewart, and M. D. Petersen

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THE MEASUREMENT OF CHANGE IN WELL-BEING

M. Beaudet, B. Stewart, & M. D. Petersen

Current theories in gerontology suggest that the process of aging is accompanied by change and findings based on cross-sectional studies have provided evidence that aging processes include changes in health resources, social resources, and financial resources. Less explored, however, is the study of intra-individual change based on longitudinal data. Factors which have served as a deterrent to the exploration of intra-individual change are numerous. Among them, are the costs associated with longitudinal studies and the controversy surrounding the measurement of longitudinal change. The purpose of this study is to determine if three quantitative approaches to the measurement of longitudinal change yield similar results when the relationships between subjective well-being and measures of health, social, and financial resources are analyzed. For the present study, the three selected approaches to the measurement of longitudinal change are: difference scores, residual change scores, and percentage gain scores.

The controversy surrounding the measurement of change in longitudinal data has focused on two approaches to the evaluation of change, the use of difference scores or raw gain scores and the use of residual change scores or base free measures of change. Cronbach and Furby (1970) have underscored the negative psychometric properties of difference scores, including low reliability and negative correlation with time 1 scores. They argue that these factors may lead an investigator to draw faulty conclusions and they recommend the use of residual change scores. In contrast, Rogosa, Brandt, and Zimowski (1982) argue that difference scores are a meaningful way of measuring

intra-individual change and that residual change scores answer a related but different question. They acknowledge the limitations of difference scores in terms of their psychometric properties but state that these limitations are particularly evident with data from two waves only. Finally, they caution against the use of residual change scores when outliers are present because, in that instance, large residuals tend to be associated with non-outliers.

The data which were analyzed for this study are those of the Retirement History Study (RHS), a longitudinal study sponsored by the Social Security Administration. The sample consists of 8922 respondents who participated in the first three waves of data collection, in 1969, in 1971, and in 1973. The sample is composed of predominantly white respondents (89%, n = 7949), males (72%, n = 6411), between the ages of 58 and 63 in 1969 (mean age = 60). The majority of the respondents have finished high school (82.6%, n = 7365), are working (72.8%, n = 6493) and are living with a spouse (63.3%, n = 6493).

The outcome or dependent variable for the current study is measured by a single item with a three-point range. It assesses the happiness of the respondents and was worded in an identical fashion in all three waves of data collection. The predictor or independent variables were selected from three resource areas: health, social, and financial resources. The area of health resources is measured by two indexes, General Disability and Overall Disability. Both indexes are summative and assess the extent to which health and/or physical disability limit a respondent's ability to work and/or to get around. A high score on these indexes represents a high degree of disability

in terms of mobility and ability to work. The indexes are composed of identical items across the three waves of data. Because the indexes have component items which are overlapping, they are used in separate regression analyses. The area of social resources is measured by two indexes: Scope of Immediate Family and Size of Immediate Family. Both indexes are summative and are composed of identical items across waves. A high score on these indexes indicates that a respondent has immediate family members in the following four roles: a spouse, a parent, a child, and a sibling. The indexes are used in separate analyses because they are based on the same items. The area of financial resources is measured by one item which assesses a respondent's total income based on 14 categories. This measure is not based on an item which is identical across the three waves of data collection. The internal consistency and stability coefficients for the measures are presented in Tables 1 and 2. The means, standard deviations, and intercorrelations among the measures are presented in Table 3.

Evidence of the construct validity of the measures used in this study and of the construct validity of the change scores was sought in a series of repeated measures analysis of variance (ANOVA). The findings are presented in Tables 4 and 5. Two sets of analyses were carried out. The first set of analyses focuses on whether or not change occurred from 1969 to 1971, from 1971 to 1973, and from 1969 to 1973. The second set of analyses compares the rate of change. The purpose of this second set is to determine if the rate of change from 1971 to 1973 is larger than the rate of change between 1969 and 1971. These analyses also give information on whether or not change during

the 4-year interval, from 1969 to 1973, is greater than change which occurs during a 2-year interval.

Comparisons of means across the three waves of data collection reveal that the measures of health and social resources are detecting change. Because the measure of financial resources is based on an item which is not identical across the three waves of data collection, the means could not be compared for that resource area. On the average, respondents report more disability and less social resources as they age. Comparisons between the 2-year interval data yield greater change from 1971 to 1973 than from 1969 to 1971 for the health resources measures only. In both the health and social resource areas for these measures, the 4-year rate of change is larger than the 2-year rate of change. As mentioned previously, the two indexes measuring health resources and the two indexes measuring social resources have overlapping component items. Therefore, they offer redundant information. The reported happiness of the RHS respondents does not decline over time but increases from 1969 to 1971 and then returns to the 1969 level in 1973.

The findings from the correlational analysis indicate that the three selected approaches to the measurement of longitudinal change rank individuals similarly on the construct of change. In general, difference scores and residual change scores seem to be more highly correlated when the range of the measures is large whereas difference scores and percentage gain scores are more highly correlated when the range of the measures is comparatively small (see Table 6).

Findings from the correlational analysis indicate that change in health, social, and financial resources as measured by residual change

scores is more highly correlated with change in happiness than change based on difference scores or percentage gain scores (see Tables 7, 8, and 9). Findings from the regression analyses indicate that residual change scores explain more variance in both happiness at a later-point-in-time and in change in happiness than do difference scores or percentage gain scores. Moreover, with the use of residual change scores, the order of entry of the predictor variables can be replicated for both versions of the outcome measure and with both sets of predictor variables which vary in terms of range of scores. For residual change scores, the order of entry of the predictor variables is: change in health followed by change in income. Change in social resources contributes relatively little to the regression equation. Residual change scores explain more variance in the analysis of 4-year interval data than they do in the analysis of 2-year interval data. Finally, residual change scores explain less variance (between 1 and 2% less) in the change in happiness outcome than they do in the happiness at a later-point-in-time outcome. These findings are presented in Tables 10 and 11.

The correlation coefficients of difference scores, residual change scores, and percentage gain scores with one-point-in-time measures which are presented in Table 12 illustrate that the three selected approaches to the measurement of change in longitudinal data tend to correlated positively with the time 2 measures from which they are derived. This pattern is particularly pronounced when the change is measured with residual change scores. The more the stability between time 1 and time 2, the less the residual scores are correlated with the time 2 measures. As expected, difference scores are negatively correlated with time 1 scores and residual scores have

close to 0 correlation with time 1 scores. Percentage gain scores generally seem to hold a middle ground between residual change scores and difference scores. The negative correlation between percentage gain scores and time 1 scores is not as pronounced as for difference scores but is also not .00 as for residual change scores. Similarly, the positive correlation between percentage gain scores and time 2 scores is not as great as for residual change scores but is greater than that for difference scores.

In sum, when the approach to the measurement of change is varied, different results are obtained both in terms of the amount of variance explained and in terms of the relative importance of a resource area for predicting happiness and change in happiness outcomes. In general, residual change scores explain more variance in the outcome than do difference scores and percentage gain scores. A greater amount of consistency is also obtained with residual change scores in the order of entry of the predictor variables. However, residual change scores are highly correlated with the time 2 scores from which they are computed, a phenomenon not emphasized in the measurement of change literature. Improving the reliability of measures used to assess change, allowing adequate time for change to occur, and using sample sizes which are large will maximize the possibility of obtaining correlation coefficients based on change scores which are large and stable. The use of both difference scores and residual change scores in combination is warranted to assess intra-individual change in aging studies.

REFERENCE LIST

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Table 1

Internal Consistency Coefficients for the Health, Social, Financial, and Subjective Well-being Indexes in 1969, 1971, and 1973

Resource Area Index/Item	Number of items/ indexes	1969	1971	1973
Health Resources				
General Disability	2	0.79 (n=8916)	0.79 (n=8890)	0.78 (n=8899)
Overall Disability[a]	2	0.75 (n=8399)	0.74 (n=8407)	0.72 (n=8432)
Social Resources				
Scope of Immediate Family	4	0.24 (n=8886)	0.23 (n=8734)	0.24 (n=8720)
Size of Immediate Family	4	0.22 (n=8886)	0.21 (n=8734)	0.22 (n=8720)
Financial Resources				
Income	1	b	b	b
Subjective Well-being				
Happiness	1	b	b	b

Note. The internal consistency estimates were calculated for the sample of continuers, n=8922. The sample size varies due to the listwise deletion of cases with missing values on one or more variables.

[a] This index is composed of two other indexes, work limitations and mobility limitations.

[b] This measure is composed of one item therefore the internal consistency estimate could not be computed.

Table 2

Two-year and Four-year Stability Coefficients for the Indexes Measuring Health, Social, Financial Resources and Subjective Well-being

Resource Area Index/Item	1969-1971	1971-1973	1969-1973
Health Resources			
General Disability	0.60 (n=8884)	0.56 (n=8867)	0.52 (n=8893)
Overall Disability	0.68 (n=7929)	0.65 (n=7940)	0.58 (n=7924)
Social Resources			
Scope of Immediate Family	0.91 (n=8701)	0.92 (n=8545)	0.88 (n=8589)
Size of Immediate Family	0.94 (n=8701)	0.94 (n=8545)	0.93 (n=8589)
Financial Resources			
Income	0.81 (n=8430)	0.84 (n=8452)	0.76 (n=8363)
Subjective Well-being:			
Happiness	0.42 (n=8818)	0.42 (n=8847)	0.37 (n=8803)

Table 3

Means, Standard Deviations, and Intercorrelations Among Health, Social, Financial, and Subjective Well-being Measures for the 1969, 1971, and 1973 Waves of Data Collection

Resource Area Index/Item		Year	(1)	(2)	(3)	(4)	(5)	(6)
Health Resources								
General Disability	(1)	1969		0.90 (n=8385)	-0.02 (n=8880)	0.05 (n=8880)	-0.28 (n=8610)	-0.25 (n=8841)
		1971		0.90 (n=8390)	-0.02 (n=8704)	0.04 (n=8704)	-0.30 (n=8653)	-0.25 (n=8859)
		1973		0.91 (n=8405)	0.01 (n=8697)	0.07 (n=8697)	-0.27 (n=8598)	-0.27 (n=8855)
Overall Disability	(2)	1969			-0.05 (n=8349)	0.03 (n=8349)	-0.35 (n=8100)	-0.29 (n=8313)
		1971			-0.04 (n=8220)	0.04 (n=8220)	-0.38 (n=8164)	-0.30 (n=8363)
		1973			-0.00 (n=8217)	0.06 (n=8217)	-0.32 (n=8123)	-0.30 (n=8365)
Social Resources								
Scope of Immediate Family	(3)	1969				0.69 (n=8886)	0.30 (n=8582)	0.07 (n=8812)
		1971				0.69 (n=8734)	0.30 (n=8507)	0.07 (n=8705)
		1973				0.70 (n=8720)	0.31 (n=8437)	0.06 (n=8680)
Size of Immediate Family	(4)	1969					0.06 (n=8582)	-0.03 (n=8812)
		1971					0.05 (n=8507)	-0.01 (n=8705)
		1973					0.06 (n=8437)	-0.02 (n=8680)
Financial Resources								
Income	(5)	1969						0.29 (n=8556)
		1971						0.29 (n=8557)
		1973						0.27 (n=8584)
Subjective Well-being								
Happiness	(6)	1969						
		1971						
		1973						
Mean, standard deviation, and sample size		1969	2.93 (4.12) (n=9916)	1.50 (2.52) (n=8385)	6.27 (2.21) (n=8886)	4.97 (2.11) (n=8886)	8.48 (3.79) (n=8616)	5.41 (3.40) (n=8846)
		1971	3.16 (4.21) (n=8890)	1.75 (2.72) (n=8390)	6.16 (2.15) (n=8734)	4.90 (2.11) (n=8734)	8.57 (3.79) (n=8582)	5.69 (3.41) (n=8890)
		1973	3.71 (4.34) (n=8899)	2.24 (2.96) (n=8406)	6.03 (2.14) (n=8720)	4.78 (2.13) (n=8720)	8.63 (3.58) (n=8616)	5.61 (3.50) (n=8878)

Note. The sample size for the continuers is 8922. The variations in sample size are due to the pairwise deletion of cases with a missing value on one or both variables.

All correlations greater than .035 are significant at $p < .001$.

Table 4

Significant Differences Between Pairs of Means for the 1969, 1971, and 1973 Items and Indexes and for Difference Scores and Percentage Gain Scores Measuring Health, Social Resources, and Subjective Well-being

Resource Area Index/Item	1969-1971	1971-1973	1969-1973
Health Resources			
General Disability	**	**	**
Overall Disability	**	**	**
Social Resources			
Scope of Immediate Family	**	**	**
Size of Immediate Family	**	**	**
Subjective Well-being			
Happiness	**	NS	**

Difference Scores	1969-1971/1971-1973	1971-1973/1969-1973	1969-1971/1969-1973
Health Resources			
General Disability	**	**	**
Overall Disability	**	**	**
Social Resources			
Scope of Immediate Family	NS	**	**
Size of Immediate Family	NS	**	**
Subjective Well-being			
Happiness	**	**	NS

Percentage Gain Scores	1969-1971/1971-1973	1971-1973/1969-1973	1969-1971/1969-1973
Health Resources			
General Disability	NS	NS	**
Overall Disability	**	**	**
Social Resources			
Scope of Immediate Family	NS	**	**
Size of Immediate Family	NS	**	**
Subjective Well-being			
Happiness	**	**	NS

Note. Comparisons between means over time were only made for indexes and items which are identical across waves of data collection. The repeated measures analysis of variance could not be computed for the residual change scores because the mean of residuals is 0.

The ** indicates that the means are significantly different from each other at the $p = .01$ level. The symbol "NS" indicates that the means are not significantly different from each other at the $p = .01$ level.

Table 5

Comparison of Means for the 1969, 1971, and 1973 Items and Indexes and for the Difference Scores and Percentage Gain Scores on the Items and Indexes Measuring Health, Social Resources, and Subjective Well-being

Resource Area Index/Item	1969	1971	1973	F	critical difference
Health Resources					
General Disability	2.94 (4.12)	3.17 (4.21)	3.71 (4.34)	176.29	.1228
Overall Disability	1.45 (2.50)	1.70 (2.70)	2.16 (2.94)	360.26	.0776
Social Resources					
Scope of Immediate Family	6.30 (2.20)	6.17 (2.15)	6.06 (2.13)	272.71	.0305
Size of Immediate Family	5.00 (2.10)	4.91 (2.11)	4.80 (2.12)	310.38	.0237
Subjective Well-being					
Happiness	5.41 (3.40)	5.71 (3.41)	5.62 (3.51)	28.20	.1167
	1969-1971	1971-1973	1969-1973	F	critical difference
Difference Scores					
Health Resources					
General Disability	0.23 (3.73)	0.54 (4.00)	0.77 (4.16)	53.85	.1521
Overall Disability	0.24 (2.07)	0.46 (2.34)	0.70 (2.49)	102.84	.0934
Social Resources					
Scope of Immediate Family	-0.13 (0.92)	-0.11 (0.88)	-0.24 (1.09)	71.38	.0348
Size of Immediate Family	-0.09 (0.73)	-0.11 (0.70)	-0.20 (0.81)	74.15	.0288
Subjective Well-being					
Happiness	0.29 (3.65)	-0.09 (3.74)	0.20 (3.85)	31.78	.1471
Percentage Gain Scores					
Health Resources					
General Disability	0.02 (0.46)	0.05 (0.49)	0.08 (0.51)	47.09	.0601
Overall Disability	-0.02 (0.36)	0.01 (0.38)	0.04 (0.38)	62.12	.0152
Social Resources					
Scope of Immediate Family	-0.01 (0.15)	-0.01 (0.15)	-0.03 (0.17)	40.32	.0057
Size of Immediate Family	-0.02 (0.14)	-0.03 (0.15)	-0.05 (0.17)	88.85	.0054
Subjective Well-being					
Happiness	0.06 (0.54)	0.01 (0.54)	0.05 (0.56)	29.52	.0212

Note. The means are presented as the first member of the pair and the standard deviations are in parentheses. The values of the means and standard deviations may vary slightly from those presented in the descriptive statistics tables due to the listwise deletion of cases with missing values.

The sample sizes associated with each index or item starting with the General disability index are 8861, 7517, 8515, 8515, and 8776.

The critical difference was computed as follows:

$$\text{critical difference} = \frac{MS_{res}}{n} \times \text{critical value}$$

where the critical value is equal to 4.12 for a Tukey test with means three steps apart and $p = .01$.

No repeated measures analysis of variance can be computed for the residual change scores because their means is 0.

Table 6

Correlation Coefficients Among the Three Ways of Measuring Change for the Areas of Health, Social, Financial, and Subjective Well-Being

Resource Area Index/Item	Year	Difference Score With Residual Change Score	Difference Score With Percentage Gain Score	Residual Change Score With Percentage Gain Score
Health Resources				
General Disability	69-71	.90 (n=8884)	.95 (n=8884)	.89 (n=8884)
	71-73	.90 (n=8857)	.95 (n=8857)	.88 (n=8857)
	69-73	.89 (n=8893)	.95 (n=8893)	.88 (n=8893)
Overall Disability	69-71	.95 (n=7929)	.88 (n=7929)	.85 (n=7929)
	71-73	.94 (n=7940)	.88 (n=7940)	.85 (n=7940)
	69-73	.95 (n=7924)	.90 (n=7924)	.87 (n=7924)
Social Resources				
Scope of Immediate Family	69-71	.96 (n=8701)	.92 (n=8701)	.92 (n=8701)
	71-73	.97 (n=8545)	.93 (n=8545)	.92 (n=8545)
	69-73	.95 (n=8589)	.93 (n=8589)	.92 (n=8589)
Size of Immediate Family	69-71	.99 (n=8701)	.91 (n=8701)	.92 (n=8701)
	71-73	.99 (n=8545)	.90 (n=8545)	.91 (n=8545)
	69-73	.98 (n=8589)	.90 (n=8589)	.92 (n=8589)
Financial Resources				
Income	69-71	.95 (n=8430)	.84 (n=8430)	.89 (n=8430)
	71-73	.93 (n=8452)	.85 (n=8452)	.89 (n=8452)
	69-73	.90 (n=8363)	.86 (n=8363)	.90 (n=8363)
Subjective Well-being				
Happiness	69-71	.85 (n=8818)	.94 (n=8818)	.88 (n=8818)
	71-73	.85 (n=8847)	.94 (n=8847)	.88 (n=8847)
	69-73	.84 (n=8803)	.94 (n=8803)	.88 (n=8803)

Table 7

Means, Standard Deviations, and Intercorrelations Among Change in Health, Social, Financial Resources, and Subjective Well-being as Measured by Difference Scores

Resource Area / Index/Item		year	(1)	(2)	(3)	(4)	(5)	(6)
Health Resources								
General Disability	(1)	69-71		.82 (n=7929)	.03 (n=8865)	.02 (n=8865)	-.06 (n=8396)	-.06 (n=8703)
		71-73		.85 (n=7939)	.00 (n=8493)	.01 (n=8493)	-.09 (n=8406)	-.08 (n=8793)
		69-73		.84 (n=7923)	.02 (n=8860)	.02 (n=8860)	-.10 (n=8339)	-.10 (n=8775)
Overall disability	(2)	69-71			.02 (n=7739)	.01 (n=7739)	-.10 (n=7498)	-.08 (n=7859)
		71-73			.00 (n=7609)	.00 (n=7609)	-.12 (n=7522)	-.10 (n=7870)
		69-73			.02 (n=7714)	.02 (n=7714)	-.14 (n=7439)	-.13 (n=7818)
Social Resources								
Scope of Immediate Family	(3)	69-71				.67 (n=8701)	.04 (n=8227)	.03 (n=8506)
		71-73				.63 (n=8545)	.06 (n=8219)	.04 (n=8478)
		69-73				.67 (n=8589)	.05 (n=8263)	.05 (n=8578)
Size of Immediate Family	(4)	69-71					.04 (n=8227)	.02 (n=8506)
		71-73					.04 (n=8219)	.01 (n=8478)
		69-73					.04 (n=8263)	.04 (n=8578)
Financial Resources								
Income	(5)	69-71						.04 (n=8348)
		71-73						.05 (n=8397)
		69-73						.08 (n=8275)
Subjective Well-being								
Happiness	(6)	69-71						
		71-73						
		69-73						
Mean, standard deviation, and sample size		69-71	0.23 (3.73) (n=8884)	0.25 (2.09) (n=7929)	-0.13 (0.92) (n=8701)	-0.09 (0.73) (n=8701)	0.12 (2.30) (n=8430)	0.30 (3.66) (n=8818)
		71-73	0.54 (4.00) (n=8857)	0.47 (2.38) (n=7940)	-0.11 (0.88) (n=8545)	-0.11 (0.71) (n=8545)	0.07 (2.10) (n=8452)	-0.08 (3.74) (n=8847)
		69-73	0.77 (4.16) (n=8853)	0.72 (2.53) (n=7924)	-0.25 (1.09) (n=8589)	-0.20 (0.82) (n=8589)	0.19 (2.56) (n=8363)	0.20 (3.87) (n=8803)

Note. The sample size for the continuers is 8922. The variations in sample size are due to the pairwise deletion of cases with a missing value on one or both variables.

All correlations greater than .035 are significant at $p < .001$.

Table 8

Means, Standard Deviations, and Intercorrelations Among Change in Health, Social, Financial Resources and Subjective Well-being As Measured by Residual Change Scores

Resource Area / Index/Item		year	(1)	(2)	(3)	(4)	(5)	(6)
Health Resources								
General Disability	(1)	69-71		.84 (n=7929)	.02 (n=8565)	.02 (n=8565)	-.12 (n=8396)	-.12 (n=8703)
		71-73		.87 (n=7939)	.01 (n=8493)	.02 (n=8493)	-.11 (n=8406)	-.15 (n=8793)
		69-73		.87 (n=7923)	.02 (n=8560)	.02 (n=8560)	-.14 (n=8339)	-.17 (n=8775)
Overall Disability	(2)	69-71			.02 (n=7739)	.01 (n=7739)	-.16 (n=7498)	-.15 (n=7789)
		71-73			.01 (n=7609)	.01 (n=7609)	-.12 (n=7522)	-.16 (n=7878)
		69-73			.02 (n=7714)	.02 (n=7714)	-.18 (n=7439)	-.20 (n=7818)
Social Resources								
Scope of Immediate Family	(3)	69-71				.66 (n=8701)	.06 (n=8227)	.05 (n=8506)
		71-73				.64 (n=8545)	.08 (n=8119)	.06 (n=8478)
		69-73				.66 (n=8589)	.08 (n=8163)	.06 (n=8578)
Size of Immediate Family	(4)	69-71					.03 (n=8227)	.03 (n=8506)
		71-73					.05 (n=8119)	.02 (n=8478)
		69-73					.04 (n=8163)	.04 (n=8578)
Financial Resources								
Income	(5)	69-71						.10 (n=8348)
		71-73						.10 (n=8397)
		69-73						.13 (n=8275)
Subjective Well-being								
Happiness	(6)	69-71						
		71-73						
		69-73						
Mean, standard deviation, and sample size		69-71	0.00 (3.37) (n=8884)	0.00 (1.98) (n=7929)	0.00 (0.89) (n=8701)	0.00 (0.72) (n=8701)	0.00 (2.18) (n=8430)	0.00 (3.09) (n=8818)
		71-73	0.00 (3.59) (n=8857)	0.00 (2.24) (n=7940)	0.00 (0.85) (n=8545)	0.00 (0.70) (n=8545)	0.00 (1.95) (n=8452)	0.00 (3.19) (n=8847)
		69-73	0.00 (3.71) (n=8893)	0.00 (2.40) (n=7924)	0.00 (1.04) (n=8589)	0.00 (0.81) (n=8589)	0.00 (2.31) (n=8063)	0.00 (3.25) (n=8803)

Note. The sample size for the continuers is 8922. The variations in sample size are due to the pairwise deletion of cases with missing value on one or both variables.

All correlations greater than .035 are significant at $p < .001$.

Table 9

Means, Standard Deviations, and Intercorrelations Among Change in Health, Social, Financial Resources, and Subjective Well-being as Measured by Percentage Gain Scores

Resource Area Index/Item		year	(1)	(2)	(3)	(4)	(5)	(6)
Health Resources								
General Disability	(1)	69-71		.02 (n=7929)	.02 (n=8565)	.02 (n=8565)	-.04 (n=8396)	-.04 (n=8788)
		71-73		.02 (n=7939)	.00 (n=8493)	.01 (n=8493)	-.07 (n=8406)	-.07 (n=8793)
		69-73		.02 (n=7923)	.02 (n=8560)	.02 (n=8560)	-.08 (n=8339)	-.10 (n=8775)
Overall Disability	(2)	69-71			.03 (n=7739)	.02 (n=7739)	-.07 (n=7498)	-.06 (n=7889)
		71-73			.00 (n=7609)	.02 (n=7609)	-.08 (n=7522)	-.08 (n=7878)
		69-73			.03 (n=7714)	.03 (n=7714)	-.12 (n=7439)	-.12 (n=7818)
Social Resources								
Scope of Immediate Family	(3)	69-71				.69 (n=8701)	.05 (n=8227)	.03 (n=8506)
		71-73				.67 (n=8545)	.06 (n=8119)	.04 (n=8478)
		69-73				.70 (n=8589)	.05 (n=8163)	.05 (n=8578)
Size of Immediate Family	(4)	69-71					.05 (n=8227)	.03 (n=8506)
		71-73					.05 (n=8119)	.02 (n=8478)
		69-73					.04 (n=8163)	.04 (n=8578)
Financial Resources								
Income	(5)	69-71						.05 (n=8348)
		71-73						.06 (n=8397)
		69-73						.08 (n=8275)
Subjective Well-being								
Happiness	(6)	69-71						
		71-73						
		69-73						
Mean, standard deviation, and sample size		69-71	0.02 (0.46) (n=8884)	-0.02 (0.36) (n=7929)	-0.01 (0.15) (n=8701)	-0.02 (0.14) (n=8701)	0.03 (0.33) (n=8430)	0.06 (0.54) (n=8818)
		71-73	0.05 (0.49) (n=8857)	0.01 (0.38) (n=7940)	-0.01 (0.15) (n=8545)	-0.03 (0.15) (n=8545)	0.04 (0.31) (n=8452)	0.01 (0.54) (n=8847)
		69-73	0.08 (0.50) (n=8893)	0.04 (0.39) (n=7924)	-0.03 (0.18) (n=8589)	-0.05 (0.17) (n=8589)	0.06 (0.35) (n=8363)	0.05 (0.56) (n=8803)

Note. The sample size for the continuers is 8922. The variations in sample size are due to the pairwise deletion of cases with a missing value on one or both variables.

All correlations greater than .035 are significant at $p < .001$.

Table 10

Beta Weights for Predicting Happiness from Change in Health, Social, and Financial Resources for Each of the Three Approaches to the Measurement of Change at Each of the Three Waves of Data Collection

Change Measure Index/Item	1969-1971 Order of entry	1969-1971 beta	1971-1973 Order of entry	1971-1973 beta	1969-1973 Order of entry	1969-1973 beta
Difference score						
Overall Disability	1	-0.08	1	-0.08	1	-0.14
Size of Immediate Family	3	0.03	2	0.03	2	0.04
Income	2	0.04	-	-	3	0.02
	R^2 = 0.01		R^2 = 0.01		R^2 = 0.02	
Residual change score						
Overall Disability	1	-0.15	1	-0.17	1	-0.20
Size of Immediate Family	3	0.03	3	0.02	3	0.03
Income	2	0.11	2	0.09	2	0.12
	R^2 = 0.04		R^2 = 0.04		R^2 = 0.06	
Percentage gain score						
Overall Disability	2	-0.07	1	-0.09	1	-0.13
Size of Immediate Family	3	0.03	3	0.03	3	0.04
Income	1	0.12	2	0.07	2	0.10
	R^2 = 0.02		R^2 = 0.02		R^2 = 0.03	
Difference Score						
General Disability	3	-0.04	1	-0.05	1	-0.08
Scope of Immediate Family	2	0.04	2	0.05	2	0.06
Income	1	0.04	-	-	3	0.02
	R^2 = 0.01		R^2 = 0.01		R^2 = 0.01	
Residual change score						
General Disability	1	-0.13	1	-0.16	1	-0.18
Scope of Immediate Family	3	0.05	3	0.06	3	0.06
Income	2	0.11	2	0.10	2	0.12
	R^2 = 0.04		R^2 = 0.04		R^2 = 0.06	
Percentage gain score						
General Disability	3	-0.04	2	-0.06	2	-0.09
Scope of Immediate Family	2	0.04	3	0.05	3	0.05
Income	1	0.12	1	0.08	1	0.10
	R^2 = 0.02		R^2 = 0.01		R^2 = 0.02	

Note. The outcome in the 1969-1971 analysis is the happiness item in 1971.. Likewise, the outcome in the 1971-1973 and in the 1969-1973 analyses is the happiness item in 1973.

The dash (-) indicates that the variable did not reach the level of statistical significance ($p < .05$) necessary to be entered into the regression analysis.

The sample sizes for the regression analyses with Overall Disability, Size of Immediate Family, and Income as the independent variables are 7303 for the 1969-1971 wave of data collection, 720/ for the 1971-1973 wave, and 7233 for the 1969-1973 wave. The sample sizes for the regression analyses with General Disability, Scope of Immediate Family, and Income are 8172, 8044, and 8108 for the 1969-1971, 1971-1973, and 1969-1973 waves of data collection.

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Table 11

Beta Weights for Predicting Change in Happiness from Change in Health, Social, and Financial Resources for Each of the Three Approaches to the Measurement of Change at Each of the Three Waves of Data Collection

Change Measure Index/Item	1969-1971 Order of entry	1969-1971 beta	1971-1973 Order of entry	1971-1973 beta	1969-1973 Order of entry	1969-1973 beta
Difference score						
Overall Disability	1	-0.08	1	-0.10	1	-0.12
Size of Immediate Family	3	0.02	-	-	3	0.04
Income	2	0.03	2	0.04	2	0.06
	$R2 = 0.01$		$R2 = 0.01$		$R2 = 0.02$	
Residual change score						
Overall Disability	1	-0.13	1	-0.16	1	-0.19
Size of Immediate Family	3	0.03	-	-	3	0.04
Income	2	0.08	2	0.07	2	0.10
	$R2 = 0.03$		$R2 = 0.03$		$R2 = 0.05$	
Percentage gain score						
Overall Disability	1	-0.06	1	-0.08	1	-0.11
Size of Immediate Family	3	0.03	3	0.02	3	0.04
Income	2	0.05	2	0.04	2	0.07
	$R2 = 0.01$		$R2 = 0.01$		$R2 = 0.02$	
Difference Score						
General Disability	1	-0.06	1	-0.08	1	-0.10
Scope of Immediate Family	3	0.03	3	0.03	3	0.04
Income	2	0.03	2	0.05	2	0.06
	$R2 = 0.01$		$R2 = 0.01$		$R2 = 0.02$	
Residual change score						
General Disability	1	-0.11	1	-0.14	1	-0.16
Scope of Immediate Family	3	0.04	3	0.05	3	0.06
Income	2	0.08	2	0.08	2	0.10
	$R2 = 0.02$		$R2 = 0.03$		$R2 = 0.04$	
Percentage gain score						
General Disability	2	-0.04	1	-0.07	1	-0.10
Scope of Immediate Family	3	0.03	3	0.03	3	0.04
Income	1	0.05	2	0.05	2	0.07
	$R2 = 0.00$		$R2 = 0.01$		$R2 = 0.02$	

Note. The outcome in the 1969-1971 analysis is the change in happiness from 1969 to 1971. Likewise, the outcome in the 1971-1973 and in the 1969-1973 analyses is the change in happiness from 1971 to 1973 and from 1969 to 1973 respectively.

The dash (-) indicates that the variable did not reach the level of statistical significance ($p < .05$) necessary to be entered into the regression analysis.

The sample sizes for the regression analyses with Overall Disability, Size of Immediate Family, and Income as the independent variables are 7255 for the 1969-1971 wave of data collection, 7190 for the 1971-1973 wave, and 7183 for the 1969-1973 wave. The sample sizes for the regression analyses with General Disability, Scope of Immediate Family, and Income are 8120, 8023, and 8055 for the 1969-1971, 1971-1973, and 1969-1973 waves of data collection.

Table 12

Correlation Coefficients Between One Point in Time Measures and the Three Approaches to the Measurement of Change for the Indexes and Items Measuring Health, Social, Financial Resources, and Subjective Well-being

Resource Area		Difference Scores			Residual Change Scores			Percentage Gain Scores		
Index/Item	Year	1969-1971	1971-1973	1969-1973	1969-1971	1971-1973	1969-1973	1969-1971	1971-1973	1969-1973
Health Resources										
General Disability	1969	-0.43 (n=8884)	-0.07 (n=8861)	-0.45 (n=8893)	0.00 (n=8884)	0.22 (n=8861)	0.00 (n=8893)	-0.35 (n=8884)	-0.03 (n=8861)	-0.37 (n=8893)
	1971	0.47 (n=8884)	-0.44 (n=8867)	-0.01 (n=8861)	0.80 (n=8884)	0.00 (n=8867)	0.29 (n=8884)	0.50 (n=8884)	-0.36 (n=8867)	0.04 (n=8861)
	1973	0.06 (n=8861)	0.49 (n=8867)	0.53 (n=8893)	0.32 (n=8861)	0.85 (n=8867)	0.86 (n=8893)	0.09 (n=8861)	0.53 (n=8867)	0.56 (n=8893)
Overall Disability	1969	-0.32 (n=7929)	-0.05 (n=7517)	-0.32 (n=7924)	-0.00 (n=7929)	0.20 (n=7517)	0.00 (n=7924)	-0.23 (n=7929)	0.03 (n=7517)	-0.23 (n=7924)
	1971	0.48 (n=7929)	-0.34 (n=7940)	0.09 (n=7517)	0.73 (n=7929)	0.00 (n=7940)	0.32 (n=7517)	0.46 (n=7929)	-0.22 (n=7940)	0.12 (n=7517)
	1973	0.14 (n=7517)	0.50 (n=7940)	0.59 (n=7924)	0.35 (n=7517)	0.76 (n=7940)	0.81 (n=7924)	0.13 (n=7517)	0.52 (n=7940)	0.58 (n=7924)
Social Resources										
Scope of Immediate Family	1969	-0.27 (n=8701)	-0.15 (n=8515)	-0.31 (n=8589)	0.00 (n=8701)	0.10 (n=8515)	0.00 (n=8589)	-0.16 (n=8701)	-0.01 (n=8515)	-0.19 (n=8589)
	1971	0.16 (n=8701)	-0.23 (n=8545)	-0.05 (n=8515)	0.41 (n=8701)	0.00 (n=8545)	0.24 (n=8515)	0.23 (n=8701)	-0.12 (n=8545)	0.05 (n=8515)
	1973	0.05 (n=8515)	0.18 (n=8545)	0.19 (n=8589)	0.29 (n=8515)	0.40 (n=8545)	0.48 (n=8589)	0.12 (n=8515)	0.26 (n=8545)	0.28 (n=8589)
Size of Immediate Family	1969	-0.17 (n=8701)	-0.03 (n=8515)	-0.17 (n=8589)	-0.00 (n=8701)	0.12 (n=8515)	0.00 (n=8589)	0.01 (n=8701)	0.11 (n=8515)	0.04 (n=8589)
	1971	0.18 (n=8701)	-0.15 (n=8545)	0.03 (n=8525)	0.34 (n=8701)	0.00 (n=8545)	0.19 (n=8515)	0.33 (n=8701)	0.01 (n=8545)	0.21 (n=8515)
	1973	0.06 (n=8515)	0.18 (n=8545)	0.22 (n=8589)	0.22 (n=8515)	0.33 (n=8545)	0.38 (n=8589)	0.21 (n=8515)	0.31 (n=8545)	0.38 (n=8589)
Financial Resources										
Income	1969	-0.32 (n=8430)	-0.18 (n=8223)	-0.43 (n=8363)	0.00 (n=8430)	0.13 (n=8223)	0.00 (n=8363)	-0.00 (n=8430)	0.06 (n=8223)	-0.11 (n=8363)
	1971	0.29 (n=8430)	-0.37 (n=8452)	-0.05 (n=8223)	0.58 (n=8430)	-0.00 (n=8452)	0.34 (n=8223)	0.52 (n=8430)	-0.06 (n=8452)	0.20 (n=8223)
	1973	0.12 (n=8223)	0.19 (n=8452)	0.26 (n=8363)	0.38 (n=8223)	0.54 (n=8452)	0.65 (n=8363)	0.32 (n=8223)	0.43 (n=8452)	0.51 (n=8363)
Subjective Well-being										
Happiness	1969	-0.53 (n=8818)	-0.04 (n=8776)	-0.54 (n=8803)	0.00 (n=8818)	0.22 (n=8776)	0.00 (n=8803)	-0.37 (n=8818)	0.03 (n=8776)	-0.38 (n=8803)
	1971	0.54 (n=8818)	-0.52 (n=8847)	0.00 (n=8776)	0.91 (n=8818)	0.00 (n=8847)	0.28 (n=8776)	0.64 (n=8818)	-0.37 (n=8847)	0.08 (n=8776)
	1973	0.04 (n=8776)	0.56 (n=8847)	0.58 (n=8803)	0.28 (n=8776)	0.91 (n=8847)	0.93 (n=8803)	0.11 (n=8776)	0.65 (n=8847)	0.68 (n=8803)